DEPARTMENT OF RADIOLOGY AND BIOMEDICAL IMAGING STANDARD OPERATING PROCEDURES

Administrative SOP:	**Use of IV and Oral Contrast Media in Radiology**		
Reviewed:	4/99, 10/07, 8/08,1/09, 3/09, 4/09, 6/7/10, 8/10, 3/11, 8/11, 9/12, 6/13, 9/13, 11/13, 2/14, 8/15, 1/17, 6/19, 10/21, 6/22, 12/22	**Revised / Reviewed**	1/23
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PURPOSE

To provide guidelines for the use of intravenous or oral, iodinated and gadolinium based contrast media, as well as the proper response of Radiology staff in the event of a contrast media event.

RESPONSIBILITY

1. IV and oral contrast media agents are considered medications according to the Joint Commission and, therefore, all adherences to the Medication Management Standards and all applicable YNHH drug use policies apply.
2. The patient's physician, PA, or APRN is responsible to order radiology exams, including those that require contrast media, either by written requisition or via computer order entry system. Inpatient and ED requests for contrast exams must include the patient's pregnancy status and renal function as appropriate.
3. The radiologist has primary responsibility to review pertinent, available patient history, including eGFR levels when applicable, and the appropriateness of the request for contrast media. The dose and the type of contrast administered will usually be pre-assigned per protocol performed.
4. Per YDR and DR administration, the responsibility to protocol CT exams with contrast is limited to radiology physicians and/or advanced practitioners, unless exam is eligible for autoprotocol. For exams ordered with IV contrast, the patient's eGFR should be ≥ 30. If the eGFR is < 30, should follow low eGFR workflow as follows:
    a. eGFR results for inpatient and ED patients should be within 48 hours. All inpatients and ED patients require a results value in order to proceed with contrast administration unless exam is eligible for eGFR bypass.
    b. Please note, any outpatient that answers "Yes" to a renal risk factor question on the CT Oral/IV Contrast Questionnaire requires a renal function assessment. Those patients without risk factors do not require renal testing prior to receiving IV contrast. Patients will be given a Point of Care (POC) eGFR test to determine eGFR level if no eGFR value is available within 6 weeks in Epic. eGFR levels under 30 are referred to the radiologist.
5. All personnel involved in the administration of contrast media are responsible to be aware of the steps that can be taken to anticipate a contrast reaction in order to prevent it, or if one occurs, recognize it and take appropriate measures. *See Addendum 1.15A Recognition and Response to Contrast Reaction.*
6. **eGFR Workflow and Responsibilities for CT**
    a. If a CT study is ordered WITH contrast and eGFR is over 30, exam can be protocoled with IV contrast
    b. If a CT study is ordered WITH contrast and eGFR is below 30 when patient arrives:
        i. Technologist will call the appropriate reading room to notify a radiologist. Radiologist then has to review the case and decide how to proceed as below:
            1. **Give contrast despite eGFR <30:** A few studies have shown NO added risk of deterioration of renal function with IV contrast compared to matched controls regardless of renal function (2, 3, 5), however one study showed higher risk with eGFR <30 (1). If you have any doubt on the best choice, discuss with ordering provider and document reasoning in your report.
            2. **Change to CT WITHOUT contrast:** If clinical question can be answered sufficiently without IV contrast, document the following in your dictation. Example, "Current study was initially ordered with IV contrast, however

the patient's eGFR on 'date X' was 'X.' Thus, the exam was switched to without IV contrast to eliminate risk of renal injury.

a. For Technologist: Place 52 Modifier on exam and e-mail 52Limited.Imaging@ynhh.org describing why the exam is being changed to without IV contrast.

3. Exam should be canceled/rescheduled: If exam canceled, Clinical Scheduling Assistant (CSA) will note the cancel reason as "lab function out of range" in the order history in Epic.

ii. Technologist should document in Epic study notes the name of radiologist who made the decision. If radiologist is ever unclear on what to do, they should discuss case with ordering provider.

iii. If order is being CHANGED (to without contrast or canceled), then Technologist will communicate the radiologist's decision to CSA and ask CSA to contact the ordering physician's office.

1. CSA, working from an approved script, will communicate the information to the ordering provider (or ordering provider's staff) including the eGFR value and the radiologist's recommendation for the patient's imaging.

a. If the ordering provider does not agree with the radiologist's decision, CSA will connect provider to radiologist for discussion. CSA will wait for further direction from the radiologist and/or technologist once that call is completed.

b. If the ordering provider agrees with the radiologist decision, the CSA will edit exam order with ordering provider using the following procedure:

i. If changing to CT WITHOUT contrast:

1. Epic Provider:
   a. CSA will change the order in Epic to a non-contrast exam and send the order via Epic in-basket request for co-sign
   b. CSA will track the order to ensure co-sign is received
2. Non-Epic Provider:
   a. CSA will change the order in Epic to a non-contrast exam
   b. CSA will request a new requisition from the ordering physician
   c. CSA will track to ensure the new requisition is received
   d. CSA will upload the new requisition into the Media Manager section of Epic
   e. Regardless of Epic or non-Epic provider, CSA will contact PFAS (PFASDrChanges@ynhh.org) to alert the pre-service team of the change in procedure code
   f. Pre-service team will address any issues with authorization
   g. CSA to track each order code via the change order excel

ii. If cancelling the exam:
    1. CSA will cancel the appointment in Epic and take direction from the ordering physician's office about reschedule

c. If CSA cannot get in touch with ordering physician (or surrogate), the radiologist's decision will prevail**. It is crucial that all our reports have documentation for reasoning to give or withhold contrast for this reason**

PROCEDURE GUIDELINES FOR INTRAVENOUS (IV) CONTRAST

1. Intravenous contrast will be injected through an intravenous line previously established by the nurse or technologist. See DR Policy *Medication Administration by Technologists in Diagnostic Radiology.*
2. Prior to the administration of IV contrast, the patient's history including medications, allergies, and questions screening for renal impairment will be reviewed by the technologist in the patient's medical record, or obtained using the appropriate outpatient questionnaire, and subsequently scanned or entered into the medical record.
    a. If no contraindications to contrast are noted, the technologist proceeds with IV contrast administration as per protocol identified by the radiologist.
    b. If contraindications are noted, the case is referred to the radiologist for further consideration.
    c. An IV line will stay in place during the examination, should IV drug therapy be necessary.
    d. A physician, APP or RN must be on site during the contrast administration.
    e. A contrast reaction kit and emergency equipment (including a code cart if a hospital site) must be readily available.

POINT OF CARE TESTING

1. Point of Care testing will be performed by the technologist/technologist aid or nursing as required for outpatients (and rarely for inpatients) at the time of the appointment. This test is inspected by the College of American Pathologists as part of the accreditation of the Department of Laboratory Medicine at Yale New Haven Hospital. The meter will diagnose the quantitative measurement of creatinine in capillary, venous, and arterial whole blood. eGFR may be calculated by meter or via EHR to evaluate renal function.
2. Point of Care meter will be maintained by the MRI and CT scan departments and a QA schedule will be strictly adhered to. Staff will be trained in the use of the meter during their orientation and reviewed for annual competency. Training will be performed by the Department of Laboratory Medicine.
3. Point of Care Renal Function Testing in Radiology
    a. MRI Patients
        i. Please see MRI safety manual for full details
    b. CT Patients
        i. Any **outpatient** that answers "Yes" to the contrast related questions on the CT Oral/IV Contrast Questionnaire will be given point of care testing to determine eGFR level if no eGFR/Cr value is available within **6 weeks.**
        ii. eGFR levels under 30 are referred to the radiologist as detailed above.

PRE-MEDICATION POLICY FOR PRIOR ALLERGIC LIKE REACTIONS TO CONTRAST MEDIA

For Planned Administration of Contrast Agents:		
Previous reaction to allergens (eg shellfish, peanuts, medications, etc):		
Mild	**Moderate**	**Severe**
None	None	None
Previous reaction to **same** class of contrast agent going to be given:		
Mild	**Moderate**	**Severe**
None	Pre-medicate and use different agent	Do not give contrast*
Previous reaction to a **different class** of Contrast agent than type to be given:		
Mild	**Moderate**	**Severe**
None	None	None

*Unless in the opinion of the responsible health care professional and supervising radiologist, the potential benefits outweigh the risks i.e. emergency situations.
In these instances, clinical provider should accompany the patient to radiology suite (whenever feasible) to aid in management if a repeat reaction occurs.

Premedication with steroids and Benadryl is now recommended only for patients who have had a reaction to contrast of a similar class (iodinated agents used during CT are one class, gadolinium based agents used during MRI are separate class) to the one planned to be given. Prophylaxis for those with reactions to oth

er allergens is no longer necessary.

This guideline has been drawn up based on the following information:

- Current estimated overall reaction risk in the general population of children and adults is less than 1% (in range of 0.2-0.6%) (Wang et al., Dillman et al.)
- Patients with a prior reaction to the same class of contrast agent being administered are **known** to be at highest risk for repeat reaction, 3 – 11% overall reaction rate with 2% break-through reaction rate even with pre-medication during CT (Mervak et al. Lasser et al).
- The current standard of care in the United States is to pre-medicate patients with steroids and diphenhydramine to decrease risk of repeat contrast reaction in patients who have had a reaction in the past to a **similar class contrast agent**.
- An IV steroid regimen (Recommended regimen below) is likely non-inferior compared to a longer PO regimen and is therefore recommended in the ED and in-patient setting to expedite imaging when needed (Mervak et al)

Exclusions

- In certain clinical circumstances the urgency of a contrast enhanced CT or MRI may outweigh the benefits and time needed to complete approved premedication protocol, necessitating that contrast medium be given in absence of premedication or with a variation in the pre-treatment protocol. This determination should be jointly agreed upon by supervising radiologist and ordering clinician and potentially the patient (if feasible) with documentation in medical record.

Allergic Like Reaction Definitions[1]:

Mild	Moderate	Severe
Limited urticaria[2] / pruritis[2]	Diffuse urticaria / pruritis	Diffuse edema, or facial edema with dyspnea
Nasal congestion	Diffuse erythema, stable vital signs	Diffuse erythema with hypotension
Cutaneous Edema	Facial edema without dyspnea	Laryngeal edema with stridor and/or hypoxia
Sneezing / conjunctivitis / rhinorrhea	Throat tightness or hoarseness without dyspnea	Wheezing / bronchospasm, significant hypoxia
Limited "itchy"/"scratchy" throat	Wheezing / bronchospasm, mild or no hypoxia	Anaphylactic shock (hypotension + tachycardia)

[1] Physiologic reactions like nausea, vomiting, feeling of warmth are unlikely to benefit from pre-medication
*[2] If the urticaria/pruritis **required medical treatment** it should be considered moderate severity.*

References:

-Wang CL, Cohan RH, Ellis JH, Caoili EM, Wang G, Francis IR. Frequency, outcome, and appropriateness of treatment of nonionic contrast media reactions. AJR 2008; 191:409–415
-Lasser EC, Berry CC, Mishkin MM, Williamson B, Zheutlin N, Silverman JM. Pretreatment with corticosteroids to prevent adverse reactions to nonionic contrast media. AJR 1994; 162:523–526
-Mervak BM, Davenport MS, Ellis JH, et al. Breakthrough reaction rates in high-risk inpatients premedicated before contrast-enhanced CT. AJR 2015; 205:77-84
-Dillman JR, Strouse PJ, Ellis JH, Cohan RH, Jan SC. Incidence and severity of acute allergic-like reactions to i.v. nonionic iodinated contrast material in children. *AJR* 2007; 188:1643-1647.

-Mervak BM, Cohan RH, Ellis JH, Khalatbari S, Davenport MS. Intravenous Corticosteroid Premedication Administered 5 Hours before CT Compared with a Traditional 13-Hour Oral Regimen. Radiology 2017; 285:425-433

-American College of Radiology Contrast Manual. 2020. https://www.acr.org/-/media/ACR/Files/Clinical-Resources/Contrast_Media.pdf

Pre-Medication Regimen:

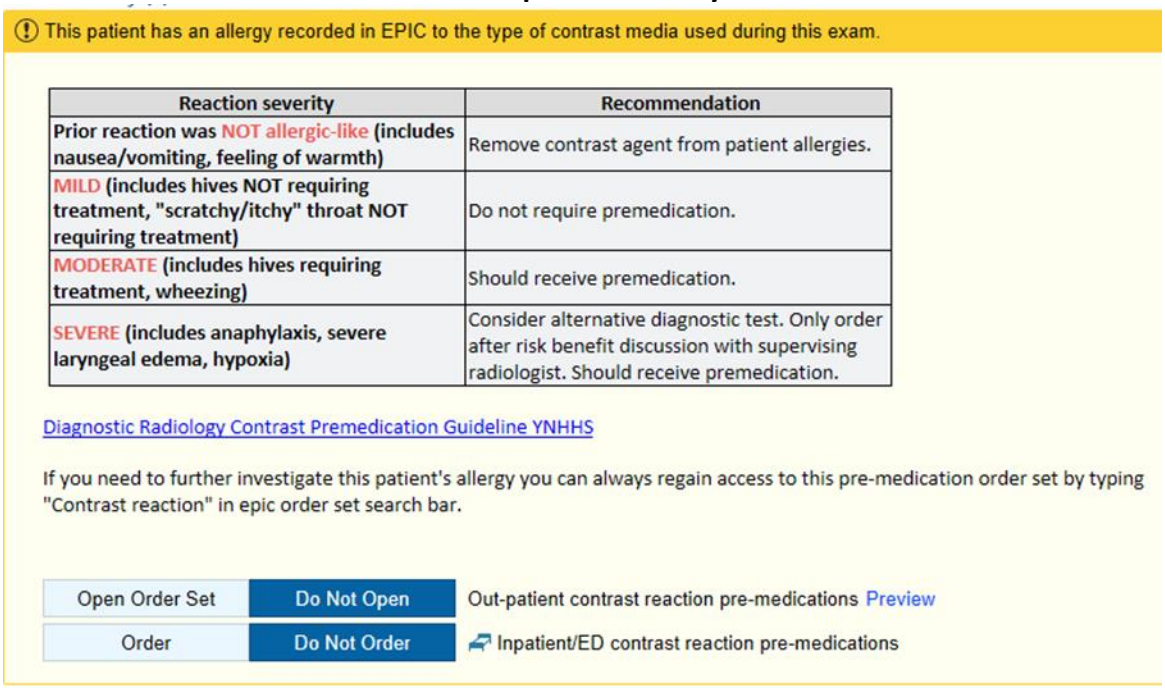
Adult Out-patients:
- 50mg prednisone PO 13, 7 and 1 hour before the injection.
- 50mg diphenhydramine (Benadryl®) IV/PO within 1 hour of the injection.

Adult ED and In-Patients- alternative faster (but less proven) regimen is:
- 200mg hydrocortisone IV 4 hours before injection.
- 50mg diphenhydramine (Benadryl®) IV/PO within 1 hour of the injection.

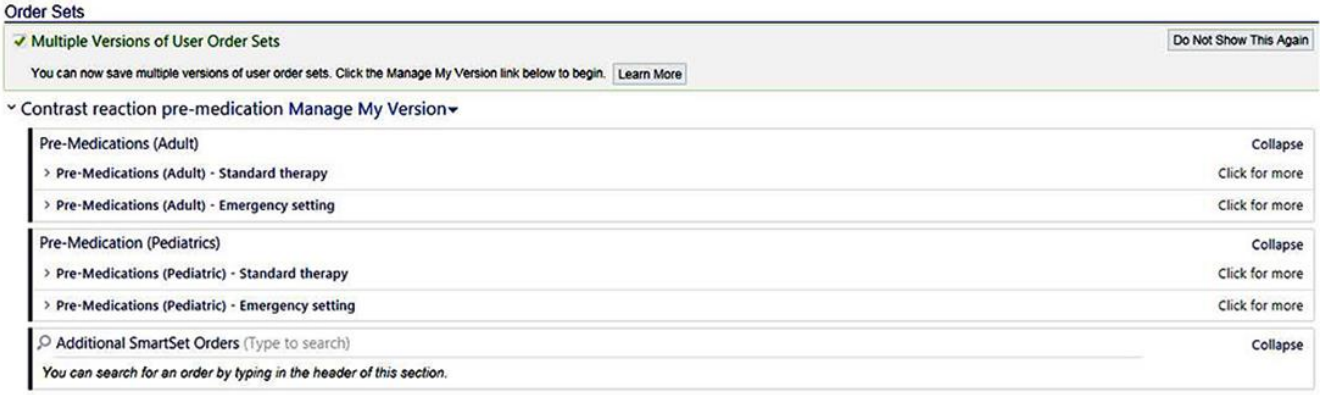
Pediatric Out-patients (For patients less than 50kg):
- Prednisone 0.7mg/kg (not to exceed 50mg) PO 13, 7 and 1 hour before the injection **OR** Prednisolone 0.7mg/kg (not to exceed 50mg) PO 13, 7 and 1 hour before the injection.
- Diphenhydramine (Benadryl®) 1mg/kg IV/PO (not to exceed 50mg) within 1 hour of the injection.

Pediatric ED and In-Patients- alternative faster (but less proven) regimen is:
- Hydrocortisone 1mg/kg (not to exceed 200mg) IV 4 hours before injection.
- Diphenhydramine (Benadryl®) 1mg/kg IV/PO (not to exceed 50mg) within 1 hour

Pre-medication Order Set is Linked to Epic Order Entry



Order set can also be found manually by searching using the work “Contrast” in Epic



What do I do if patient is allergic to a drug in the pre-medication order set?

Alternate premedication can be used if the patient is known to tolerate other classes of steroids. If needed, allergy consult may be needed for proper skin prick testing to find a suitable alternate (in many cases, the patient is not allergic to the drug itself but an additive in the drug).
For allergies to Benadryl, alternate antihistamine can be used that patient is known to tolerate.

Possible PO alternate steroid regime is 32 mg methylprednisolone 12h and 2h prior to IV contrast administration
Possible PO alternate antihistiamine is Claritin or Zyrtec 10mg PO 1h prior to IV contrast adminstration.

Pre-medication Policy for Non-Vascular Administration of Contrast in Patients with Contrast Allergy

Patients with a history of severe "allergy" to a class of contrast agents (iodinated or gadolinium-based contrast agents) could develop a severe repeat reaction even with non-vascular administration of small amounts of that class of contrast. While case reports exist for patients experiencing "allergies" with non-vascular administration of contrast media, most papers have shown risk of repeat reaction to be low with non-vascular administration (even without premedication). Given this, the following approach is suggested:

- Use alternate class of contrast when feasible (example- barium).
- Gather information on what contrast agent caused the allergic-like reaction. Use a different agent whenever feasible. For some non-vascular injections, older high osmolar iodinated contrast agents can be substituted as these are rarely given IV anymore (example- gastrogaffin, conray, etc) to reduce risk of repeat exposure to same contrast agent.
- For iodinated contrast "allergy", off-label use of gadolinium-based agents can also be pursued depending on procedure.

Guidance on need for premedication (steroid/antihistamine) if being exposed to same class of contrast media that caused allergic-like reaction is detailed below.

Premedication guidelines for previous reaction (by severity) to intravascular contrast and in need for <u>non-vascular exposure</u> of same contrast type			
<u>Reaction Severity</u>	*Mild* reaction (ex. Hives)	*Moderate* reaction (ex. Bronchospasm needing treatment)	*Severe* reaction (i.e.- anaphylactoid)
<u>Premedication Recc.</u>	None	Not routinely needed unless strong patient/clinician preference	Avoid giving contrast. If must be given, use standard premedication regimen* and be prepared to manage repeat reaction

*Unless in the opinion of the responsible health care professional and supervising radiologist, the potential benefits of not performing premedication outweigh the risks (i.e. emergency situation and cannot wait for urgent procedure). In these instances, clinical provider should accompany the patient to radiology suite (whenever feasible) to aid in management if a repeat reaction occurs. Attempt to find what contrast agent caused the event and use a different agent.

References:
- Davis PL. Anaphylactoid reactions to the nonvascular administration of water-soluble iodinated contrast media. AJR 2015; 204:1140-1145.
- Kim YS, et al. Incidence of breakthrough reaction in patients with prior acute allergic-like reactions to iodinated contrast media according to the administration route. Korean Journal of Radiology 2018; 19:352-357.
- Mohapatra A, Hyun G, Semins MJ. Trends in the usage of contrast allergy prophylaxis for endourologic procedures. Urology 2019; 131:53-56.
- Joseph JP, et al. Outcomes in patients with known contrast allergy undergoing contrast-enhanced endourologic procedures: a retrospective cohort study. Journal of Endourology 2021; 35:1857-1862

DOCUMENTATION OF ADVERSE EVENTS

1. If a contrast event occurs, the radiology nurse or technologist involved must document the details within the patient medical record (Epic). Allergy should be entered into Epic with details on what occurred and severity of reaction. The specific type of contrast used that triggered possible allergic reaction should be documented in the allergy notes in the medical record. A progess / evaluation note can also be placed by nursing in chart. The following details should be documented:
    a. Contrast agent/dose administered
    b. Reaction signs/symptoms
    c. Patient management, including drugs administered
    d. Patient outcome
    e. Provider discharge instructions sheet
2. Details concerning the administration of contrast and the adverse event should be documented in the radiology report by the radiologist whenever possible.
3. Techs must also enter a report in RL Solutions Event Reporting System
4. At the radiologist's discretion, the patient's clinician may also be notified.

CT Contrast Reaction or Urgent Adverse Patient Event Coverage* (see MRI safety manual for MRI coverage)

MONDAY -FRIDAY

_	Patient Location	Day Shift (8am-5pm)	Evenings and night (5pm-8am)
CT	SP2 (usually 7am-430pm)	Chest or Cardiac (S. Pavilion)	ED
	Smilow (Open 7am-8pm)	If neuro case, neuro MR (Smilow) Otherwise, body CT (Smilow)	Neuro or ED
	ED	ED	ED
	Saint Raphael's (Open 24/7)	Body	ED
	YNHH Nuc med PET/CT (open till 7pm)	Nuclear Medicine	Neuro (smilow)
	SRC Nuc Med PET/CT	Body	ED

SATURDAY - SUNDAY

_	Patient Location	Day Shift (8am-5pm)	Afternoon & Nights (5pm-8am)
CT	SP2	Chest if present. Otherwise ED	ED
	Smilow (Open 8am- 430 pm)	If neuro case, neuro MR (Smilow) Otherwise, body CT (Smilow)	Neuro or ED
	ED	ED	ED
	Saint Raphael's (open 24/7)	ED	ED

*Non-urgent situations such as contrast extravasation, mild contrast side effects (nausea/vomiting), and falls will be handled by the supervising service during normal business hours.

NEURO SMILOW-200-3181	PEDIATRICS-688-6184	ED YNHH-688-6180
NEURO FITKIN- 688-4305	CHEST SP- 688-8811	ED SRC-789-3929
BODY SMILOW-200-5734	CARDIAC - 688-3570	
BODY FITKIN-688-3171	SRC BODY-789-6092/3	
BREAST-200-5229	SRC MRI-789-4126	

ALGORITHM FOR RECOGNITION AND RESPONSE TO CONTRAST REACTION

MAJOR REACTIONS

BREATHING PROBLEMS OR SHOCK

a) Difficulty Breathing
b) Wheezing / Stridor
c) Facial / Neck Swelling
d) Cyanosis / Severe Diaphoresis
e) Unresponsive/hypotensive

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NOTIFY RADIOLOGIST AND NURSING

1. Assess air way and lungs
2. Check vital signs - place on monitor
3. Check ability to swallow, patient color, quality of voice

IF PROBLEM- Call CODE

Within **Hospital: Call 155**

(Code Blue = Adults)
(Code White = Pedi)

Outside New Haven: Call 9-911 (Local EMS)

MINOR REACTIONS/ PHYSIOLOGIC REACTIONS

- Nausea, vomiting
- Warmth
- Dizziness
- Altered taste
- Pallor
- Flushing
- Chills
- Sweats
- Mild nasal stuffiness
- Anxiety

If Asymptomatic

1. Comfort and reassure patient
2. Observe – continue or complete exam
3. If no further problem, can discharge.

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If no relief or symptoms persist

1. Maintain and secure IV access
2. Notify radiologist
3. Treated out-patients should be observed for 30-60 minutes before discharge if stable. Patient should be counseled to avoid driving themselves home if Benadryl give.

MANAGEMENT SUGGESTIONS FOR MAJOR ADVERSE EVENTS

ADULT:

Assess airway, heart rate, blood pressure, SPO_2, auscultate heart and lungs, obtain IV access, oxygen, monitor

Unresponsive
- CALL CODE OR 911
- Palpable Pulse? Respirations?
  - Yes → Hypotensive?
    - Yes → See Hypotensive Algorithm
    - No → Check Fingerstick Glucose
  - No → Begin Chest Compressions Refer to ACLS algorithm

Urticaria
- Diphenhydramine (Benadryl ™) 25-50mg (PO/IV/IM) OR Cetirizine (Zyrtec ™): 10 mg PO

Wheezing/ Bronchospasm
- Oxygen As Needed Elevate Head of Bed
- Albuterol Nebulizer OR Inhaler
- Still Wheezing or No Response
- ADULT EpiPen (**YELLOW Pen, 0.3mg**)
- CALL CODE OR 911

Facial/ Laryngeal Edema
- Oxygen As Needed Elevate Head of Bed
- ADULT EpiPen (**Yellow Pen, 0.3 mg**)
- CALL CODE OR 911

Hypotensive
- Elevate Legs NS Bolus (0.5-1L) Oxygen As Needed Secure Airway
- Heart Rate < 60 BPM?
  - Yes → Atropine 1 mg ***slowly IV*** (Max 3 mg) → CALL CODE OR 911
  - No → ADULT EpiPen (**Yellow Pen, 0.3 mg**) *If no response or worsening status:* Epinephrine 1-2 mL (1mg/10mL dilution) Slowly IV Push over 1-3 minutes (Can repeat up to 3 times) → CALL CODE OR 911

CODE TEAMS:
All Delivery Networks:
155

USING THE EPIPEN


1. Remove EpiPen from box


2. Pull blue safety release cap.


3. Press orange tip FIRMLY against outer thigh until it 'clicks.' Hold for 3 seconds
DO NOT PLACE FINGERS OVER ORANGE TIP

PEDIATRIC:

Assess airway, heart rate, blood pressure, SPO_2, auscultate heart and lungs, obtain IV access, oxygen, monitor

Unresponsive
- CALL CODE OR 911
- Palpable Pulse? Respirations?
  - Yes → Hypotensive?
    - Yes → See Hypotensive Algorithm
    - No → Check Fingerstick Glucose
  - No → Begin Chest Compressions Refer to ACLS algorithm

Urticaria
- Diphenhydramine (Benadryl ™) 1-2mg/kg (PO/IV/IM) Max = 50 mg OR Cetirizine (Zyrtec ™): 2 years - <6 years old: 5 mg PO Age >6: 10 mg PO

Wheezing/ Bronchospasm
- Oxygen As Needed Elevate Head of Bed
- Albuterol Nebulizer OR Inhaler
- Still Wheezing or No Response
- EpiPen Jr. (**GREEN Pen**, 0.15 mg) IM for child **<30kg** **OR** EpiPen Adult (**YELLOW Pen**, 0.3mg) for Child **≥ 30kg**
- CALL CODE OR 911

Facial/ Laryngeal Edema
- Oxygen As Needed Elevate Head of Bed
- EpiPen Jr. (**GREEN Pen**, 0.15 mg) IM for child **<30kg** **OR** EpiPen Adult (**YELLOW Pen**, 0.3mg) for Child **≥ 30kg**
- CALL CODE OR 911

Hypotensive
- Elevate Legs NS Bolus (0.5-1L) Oxygen As Needed Secure Airway
- Heart Rate < 60 BPM?
  - Yes → Atropine 0.02 mg/kg ***slowly IV*** (Max 0.5-1 mg) → CALL CODE OR 911
  - No → EpiPen Jr. (**GREEN Pen**, 0.15 mg) IM for child **<30kg** **OR** EpiPen Adult (**YELLOW Pen**, 0.3mg) for Child **≥ 30kg** *If no response or worsening status:* Epinephrine 0.1mL/kg (1mg/10mL dilution) into running IV Fluids → CALL CODE OR 911

CODE TEAMS:
All Delivery Networks:
155

USING THE EPIPEN


1. Remove EpiPen from box


2. Pull blue safety release cap.


3. Press orange tip FIRMLY against outer thigh until it 'clicks.' Hold for 3 seconds
DO NOT PLACE FINGERS OVER ORANGE TIP

DOSING AND CONTENTS OF CONTRAST REACTION KITS

Radiology Tackle Box Contents	**Adult Dosing**	**Pediatric Dosing**
Albuterol MDI INHALER 90 mcg/actuation	2 puffs (90mcg/puff) for a total of 180 mcg -May repeat	2 puffs (90 mcg/puff) for a total of 180 mcg. May repeat up to 3 times every 20 minutes
Albuterol Nebulizer 0.083% solution	2.5 mg (3 mL) inhaled via a nebulizer over 5-15 minutes	2.5 mg (3 mL) inhaled via a nebulizer over 5-15 minutes. May repeat as needed.
Atropine 1mg/10mL SYRINGE	0.5-1 mg **IV** -Administer slowly, followed by saline flush -May repeat every 3 – 5 minutes up to 3 mg total	0.02 mg/kg **IV** -May repeat every 3-5 minutes -Follow with saline flush **Infants/Children:** -MINIMUM single dose (for patients >5 kg) = 0.1 mg -MAX single dose = 0.5 mg -MAX total dose = 1 mg **Adolescents:** -MAX single dose = 1 mg -MAX total dose = 3 mg
Dextrose 50% 25g/50mL SYRINGE	25g **IV** -Administer over 2 min	0.5 g/kg **IV** -Max single dose = 25g -Administer over 2 min
Diphenhydramine 50mg VIAL	25-50 mg **IM** or **IV** -Administer IV dose slowly over 1-2 min	1-2 mg/kg **IM** or **IV** -Administer IV dose slowly over 1-2 min -MAX single dose = 50 mg
Diphenhydramine 25mg ELIXIR/CAPSULE	25-50 mg **PO**	1-2 mg/kg **PO** -MAX single dose = 50 mg
Epinephrine auto-injector (Epi-pen®) **ANAPHYLAXIS**	**Hives, diffuse erythema, bronchospasm, laryngeal edema, hypotension:** 0.3mg **IM** ****Use 0.3 mg auto-injector****	**Hives, diffuse erythema, bronchospasm, laryngeal edema, hypotension:** Weight <30 kg: 0.15 mg **IM** **(Use 0.15 mg auto-injector)** Weight ≥30 kg: 0.3 mg **IM** **(Use 0.3 mg auto-injector)**
Epinephrine 1mg/10mL PREFILLED SYRINGE for IV administration (Anaphylaxis) (1mg/10ml)	**Anaphylaxis (ONLY for very unstable patient: severe hypotension, tachycardia, severe airway edema)** 0.1 to 0.2mg SLOW **IV push** (1-2mL of 1mg/ 10ml dilution) May repeat every 5 – 15 minutes as needed up to 1 mg total	**Anaphylaxis:** 0.01 mg/kg **IV** (0.1 mL/kg of 1mg/ 10ml dilution) MAX individual dose: ≤30 kg = 0.15 mg (1.5mL) > 30 kg = 0.1 to 0.3 mg (1 mL to 3mL) -May repeat up to 1 mg total dose
Citirizine (Zyrtec)	10mg **PO**	**2-5 years: 5 mg PO** **≥6 years:** 10 mg **PO**
Methylprednisolone 125 mg VIAL	125 mg **IVP** administered over 3 minutes	0.5-1 mg/kg **IV push** over 3 minutes -MAX dose = 125 mg
Sodium chloride 0.9% 500 mL	1,000mL rapidly **IV**	10-20 mL/kg rapidly **IV** -MAX volume = 500 mL - 1,000 mL

References:
ACR Committee on Drugs and Contrast Media. ACR Manual on Contrast Media. Reviewed: March 2022

PROTOCOL FOR EXTRAVASATED CONTRAST MATERIAL

Modified from the ACR Manual of Contrast Media Manual

Background

Extravasated iodinated contrast media is hyperosmolar and toxic to the surrounding tissues. Most patients recover without sequelae but severe adverse events may occur. Extravasation produces an acute local inflammatory response that peaks at 24-48 hrs although ulceration and tissue necrosis may occur as early as 6 hours after the extravasation. Extravasation of a large volume of contrast material can produce a compartment syndrome.

Evaluation and Treatment

- All patients in which an extravasation has occurred should be evaluated by a radiologist from the service that would be reading the exam.
- All outpatients should be monitored in the department for a **minimum of 1 hour** even if the patient is asymptomatic.
- Elevation of the extremity and a cold or warm compress should be applied to the site up to four times/day for 1-3 days. Warm compress is preferred in acute phase as may be associated with quicker swelling resolution with cold compress used after initial event if patient prefers.
- If the symptoms improve or the patient remains asymptomatic, they may be sent home but told to go immediately to an ER if symptoms deteriorate or if there are skin/neurologic changes (ulceration, blistering, change in sensation).
- If symptoms have not improved after 2 hours or skin/neurologic changes develop, the patient should be referred to the emergency room.
- For inpatients, the extremity should be elevated and a warm compress should be applied (as above). Inpatients may be sent back to the floor but the house staff must be notified of the incident.
- A plastic surgical consult is frequently not necessary and a reliance of a volume threshold for surgical consultation is unreliable. In general, the need for surgical consultation should be made on the basis of the patient's signs and symptoms.
- An immediate plastic surgical consultation is indicated with the following:
    - Increasing swelling/pain after 2-4 hours.
    - Altered tissue perfusion as evidenced by decreased capillary refill
    - Change in sensation of the affected limb
    - Skin ulceration or blistering.

Documentation

- All extravasation events should be documented in the radiology report and the referring physician should be notified.
- The technologist is responsible to ensure that the extravasation incident is documented in Event Reporting system.

ACR Reference on Contrast Extravasations

"There is no clear consensus regarding effective treatment for contrast medium extravasation. Elevation of the affected extremity above the level of the heart to decrease capillary hydrostatic pressure and thereby promote resorption of extravasated fluid is recommended, but controlled studies demonstrating the efficacy of this treatment are lacking. There is no clear evidence favoring the use of either warm or cold compresses in cases of extravasation. As a result, there are some radiologists who use warm compresses and some who use cold compresses. Those who have used cold have reported that it may be helpful for relieving pain at the injection site. Those who have used heat have found it helpful in improving absorption of the extravasation as well as in improving blood flow, particularly distal to the site"

Contrast Extravasation Discharge Instructions

(FORMERLY Addendum I.15C)

During your test today, you had intravenous contrast material extravasation. This means that some of the IV fluid or contrast material went into the tissues of your arm/hand. This may cause swelling and discomfort. The fluid will be absorbed by your tissues and any symptoms should go away.

The contrast material used was_____

The approximate amount of extravasation was _____

Treatment:

- Try to keep the affected extremity elevated above the level of the heart as much as possible.
- You can apply either warm or cold compresses for 15 minutes a few times a day for 3 days or until the symptoms resolve.

Seek immediate medical attention if:

1. your swelling or pain do not improve
2. your skin blisters
3. there is increased firmness at the site
4. your arm or an area on your arm or hand becomes red
5. you experience a change in sensation of your hand or arm such as numbness and tingling

I have read and understand these instructions and received a copy.

Name of patient _____

Signature of patient _____

Radiology Policy Regarding Simultaneous Infusion of Blood Products and Contrast Media

Blood transfusion and all blood related products including FFP, platelets, and other cryoprecipitates play a vital role in patient care. Like drugs, these substances may also elicit allergic like reactions and immune responses that can potentially mimic reactions induced by IV injection of iodinated AND gadolinium-based contrast media used during CT and MRI scans respectively. In conjunction with Yale/YNHH Transfusion Medicine Services, a joint agreement was made to limit CT and MRI scans WITH CONTRAST for patients actively receiving ANY blood product to STAT or LIFE-THREATENING PRIORITY. For these studies, it is felt that the information provided by the rapid imaging outweighs any potential risk and/or uncertainty on which substance may have caused a reaction.

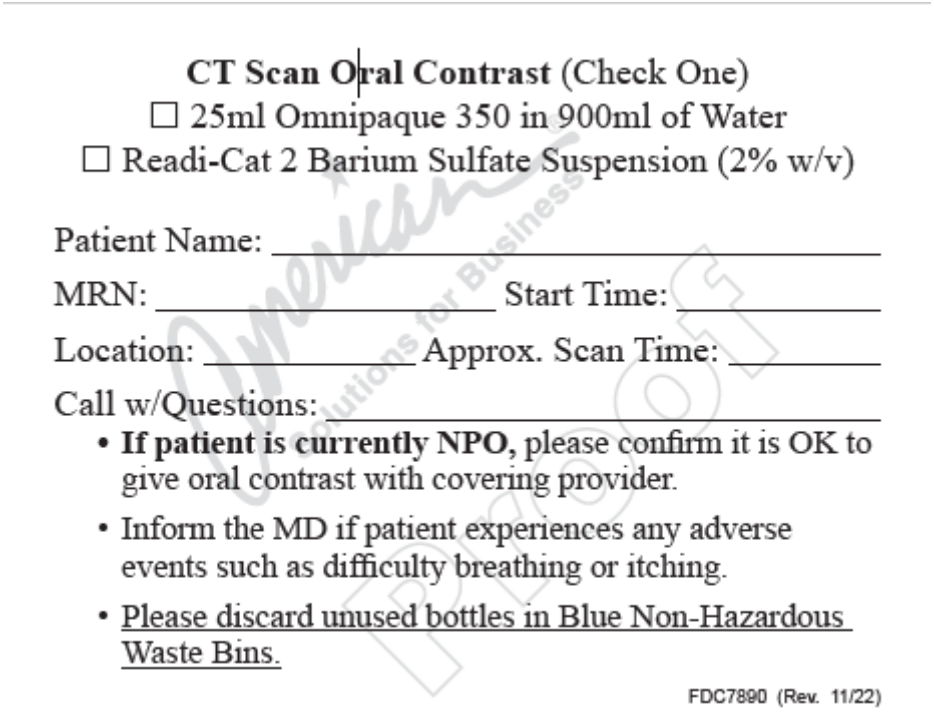
All other scans should be delayed until after the infusion is completed to avoid any mis-interpretation of a contrast reaction from a blood product reaction and vice versa. These studies can be performed immediately after the infusion is complete if necessary.

Policies Specific to CT Contrast Media

Procedure Guidelines for ORAL Contrast (All Patients)

1. Prior to the administration of oral contrast, the patient's clinical history including medications, allergies and sensitivity and drugs, will be reviewed by the technologist in the patient's medical record, or obtained using the appropriate outpatient questionnaire, and subsequently scanned or documented into the patient's medical record.
2. If no contraindications are noted, the technologist proceeds with oral contrast administration as per protocol identified by the radiologist
3. All patients routinely receive an iohexol (Omnipaque®) in water mixture, prepared according to the radiologist protocol, labeled with patient's demographics and provided to the patient or nurse with instructions for administration
4. An oral barium sulfate solution may be used for patients allergic to iodinated contrast at technologist discretion. Radiologist can be consulted when needed.
5. Patient imaging will begin approximately 45 minutes after the patient begins drinking oral contrast. Extended oral preparation may be prescribed by the radiologist at their discretion based on exam indication.
6. A contrast reaction kit and emergency equipment (including code cart, if a hospital site) must be readily available.
7. **For inpatients**: labeled oral contrast will be delivered to the inpatient floor for administration to the patient by their nursing team. **For ED patients**: contrast will be picked up in Radiology by member of patient's ED nursing team.

CT ORAL CONTRAST LABEL



CT Scan Oral Contrast (Check One)

☐ 25ml Omnipaque 350 in 900ml of Water

☐ Readi-Cat 2 Barium Sulfate Suspension (2% w/v)

Patient Name: _____

MRN: _____ Start Time: _____

Location: _____ Approx. Scan Time: _____

Call w/Questions: _____

- **If patient is currently NPO,** please confirm it is OK to give oral contrast with covering provider.
- Inform the MD if patient experiences any adverse events such as difficulty breathing or itching.
- Please discard unused bottles in Blue Non-Hazardous Waste Bins.

FDC7890 (Rev. 11/22)

Yale NewHaven Health

Metformin and Iodinated Contrast

Information for patients

This fact sheet provides instructions on how to take your oral diabetes medications containing Metformin after you receive iodinated contrast dye for a CT scan.

Diabetes medications that contain metformin include:

- Metformin (Glucophage/Glucophage XR, Glumetza, Riomet, Fortamet)
- Alogliptin/metformin (Kazano)
- Canagliflozin/metformin (Invokamet/Invokamet XR)
- Dapagliflozin/metformin (Xigduo XR)
- Empagliflozin/metformin (Synjardy/Synjardy XR)
- Ertugliflozin/metformin (Segluromet)
- Glipizide/metformin (Metaglip)
- Glyburide/metformin (Glucovance)
- Linagliptin/metformin (Jentadueto/Jentadueto XR)
- Pioglitazone/metformin (Actoplus Met/Actoplus Met XR)
- Repaglinide/metformin (Prandimet)
- Rosiglitazone/metformin (Avandamet)
- Saxagliptin/metformin (Kombiglyze XR)
- Sitagliptin/metformin (Janumet/Janumet XR)
- Vildagliptin/metformin (Eucreas)

Why should I be taking my metformin differently?

In rare instances, Metformin can cause a severe side effect called lactic acidosis. This may occur more frequently in patients with decreased kidney function. Decreased kidney function is apparent when your estimated glomerular filtration rate (eGFR) is less than 30 mL/min. Contrast dye can increase the chances of metformin causing lactic acidosis in patients with decreased kidney function.

What should I do?

If you have decreased kidney function (eGFR less than 30 mL/min):

- Stop taking metformin or metformin-containing products and contact your doctor within 48 hours before restarting.
- Bring this form with you to the doctor.

If you do not have decreased kidney function (eGFR 30 mL/min or greater):

- Continue taking metformin as originally prescribed.

Questions or concerns

If you have any questions or concerns, talk to your doctor or pharmacist.

Low-Osmolar Iodinated Contrast and Myasthenia Gravis

Low-osmolar iodinated contrast has been shown to have a weak association with exacerbation of Myasthenia Gravis-related symptoms, most commonly respiratory compromise. This association has been discussed with Yale Neurology who feel that the low risk does not merit screening patients for Myasthenia at this point. If a patient declares himself or herself as suffering from Myasthenia Gravis, our policy should be to reassure them that it is highly unlikely that any deterioration in symptoms will occur.

RADIOLOGY (CT or MRI) TECHNOLOGIST: Policy for Power Injection

** CVDs with TPN infusions cannot be used for contrast injection unless TPN has been disconnected and vigorously flushed by RN prior to exam, before patient leaves the floor.

NOTE: No IV medication drips should be stopped or restarted without an RN's help. Injector should not be used with any IV that has questionable patency. If in doubt, question the radiologist or the patient's care givers.

CVD's – Adult use

Catheter	Used for CT Inject.	Lumen Size	Max Injection Rate	Max PSI
Power PICCS (Bard) or equivalent from other manufacturer	**Yes**		**Check Hub**	**Check hub**
Power Ports (Bard) or equivalent port from other manufacturer	**Yes**	**6.5-10 French**	**5cc/sec.**	**300**
Power Hickmann	**Yes**		**Check hub**	**Check hub**
Non Power Injectable or unknown[1] ports	**Yes**		**1 cc/ sec**	**100**
Micropuncture introducers placed by IR	**Yes**	**5 French**	**5 cc**	**300**
IV catheters in a foot vein	**Yes**	**18g-22g IV access**	**1 cc/sec**	**100**
EJ or IJ - IV access (Including Cordis)	**Yes**	**18g-22g IV access**	**2 cc/ sec.** **can be increased if no other access available pending radiologist approval*	**300**
Triple-Lumen (Arrow)	**Yes**	**16g=brown port- Used whenever possible** **18g=blue port**	**1 cc/sec (unless higher rate listed on hub)**	**100 (lines that list higher injection rates at hub are usually OK to inject up to 300 psi)**

[1] Review Epic (lines and drains section) to research if type of port is known. If unknown, and need to inject at higher rate can review chest xray or scout image with radiologist to see if port is labeled with "CT" icon denoting power injectable port.

Power Mid Lines	**Yes**	**4/5 French**	**5 cc / sec**	**300**
Quinton/ Non-Power Hickman/ Permacath	**NO**			
Non- Marked Piccs	**NO**			

PROCESS

1. Following Hand Hygiene Policy at all times: wash or Purell, don gloves, when completed remove gloves, then wash or Purell.
2. *RN must access and de-access all indwelling Ports* – CVD lumen access may be performed by the CT technologist to inject contrast.
3. *Prior to use*: All CVAD lines used for contrast with injector or hand injection must have a 15 sec. hub scrub with approved disinfectant and allowed to air dry (minimum 15 sec.). **(All CVD's must be checked for patency and blood return, using a 10 cc saline syringe with 3 cc removed. Flush line with 10 cc sterile saline after.** A CVD should not be used without verification of blood return.
4. CT Technologist should monitor injection site for the duration of injection when possible.
5. The contrast for all CVD's is Omnipaque 350 (except for Pediatrics Omnipaque 300 is used). If prior contrast reaction to Omnipaque, alterative agent like Isovue 370 may be used)

SCRIPT

Adult Power Hickman – *In-Patients:* Call the floor to check IV status. If the RN states the patient has a Hickman two (2) questions need to be asked:

1. Is the Hickman a **Power Hickman** (Needs to be labeled on the clamp with maximum injection rate, if not Is a P or an X seen within the line on the Chest X-Ray or is there documentation in EPIC.
2. Has there been **TPN** running?
   a. If **Yes**: to flush vigorously now and Disconnect TPN and to clearly mark lumen used for TPN.
   b. Send patient with no meds running. (Open flush is allowed)
   c. Instruct RN that the patient will return **without** the catheter being flushed with heparin.
   d. If the TPN cannot be stopped and flushed before leaving the floor, the Hickman may not be used for the contrast injection.
   e. Follow 15 second hub scrub and allow to air dry (min. 15 seconds).
   f. Do not disconnect injector prior to exam completion or the hub scrub will need to be repeated.
   g. Maximum flow rate will be listed on the lumen clamp.

Power Hickman: *Out- patient*: Follow 15 sec. hub scrub and allow to air dry (minimum 15 sec.) Maximum flow rate will be listed on the lumen clamp. Do not disconnect injector prior to exam completion or the hub scrub will need repeating. Call South Pavilion Core IR RN, Prep Hold RN, or RN in your respected area's to flush heparin post injection per YNHH policy.

Injection Rate for Use of PEDIATRIC Peripheral IV Injections
(For Neck/Foot veins see chart above)

Lumen Size	Flow Rate	PSI
18g, 20g IV access	5cc / sec	150
22 g IV access	3cc / sec	150
24 g IV access	1.5 cc / sec	50

PEDIATRIC CENTRAL LINES INCLUDING BROVIAC
*****Only Pediatric Central Lines 4 French (around 24G) or larger should be used for contrast injections.*****
Gauge: Higher number= smaller line
French: Higher number= bigger line

Many neonate PICC's are between 1.5-3F and have a high chance of being damaged by a contrast injection. They should not be used unless approved by radiologist and ordering attending provider

Pedi- All Central Lines including Broviac: ***In- Patients****:* Call the RN. Instruct RN to accompany the patient. Pedi RN will need to follow YNHH hub scrub policy. Pedi RN will hub scrub and access the pediatric patient's **Central Line** and the technologist will connect the contrast. Omnipaque 350 may be injected @ 1 cc / sec. at 100 PSI. With the help of the CT Tech, the Pedi RN will disconnect the injector and follow YNHH heparin flush policy.

Pedi Broviac: *Outpatient*: Call Out Patient Pedi Nursing (follow same process as above)

!ALERT! Air Eliminating Filters

If you see a Pall Posidyne ELD filter or a Baxter INTERLINE System Extension Set (Air Eliminating Filters) hooked up to a patient, please STOP THE LINE and let a nurse know before proceeding. These particular filters are used for patients with patent foramen ovale (PFO), as any air introduced into their body could result in a very serious reaction. They should **NEVER** be used with a power injector.

If contrast exam is clinically necessary as determined by the Radiologist and/or the clinician, filter can be removed by RN and Technologists can inject through the IV line/CVD or start a new peripheral IV. **Technologists must be vigilant about checking for and removing all air bubbles from injector syringes/tubing prior to injection.**

Please contact Quality & Safety with any questions.

CT Intraosseous Iodinated Contrast Injection Policy

IO lines may be used for power injection of iodinated contrast for CT

1. Flush IO line with 20cc IO saline. If IO line does not flush easily, do not use.

2. If Patient is unconscious, no analgesia is required. If patient is conscious and responsive to pain, IO 2% epinephrine free lidocaine should be administered (nursing/provider responsibility) just prior to contrast as per the protocol below:

ADULT:

- Prime EZ-Connect extension set with lidocaine *Note that the priming volume of the EZ-Connect is approximately 1.0ml.*
- Slowly infuse lidocaine 40 mg IO over 2 minutes.
- Allow lidocaine to dwell in IO space for 1 minute.
- Flush with 5 to 10 mLs of normal saline.
- Slowly administer and additional 20 mg of lidocaine IO over 1 minute.

Pediatric:

- Usual dose is 0.5mg/kg, not to exceed 40mg.
- Prime EZ-Connect extension set with lidocaine.
- *Note that the priming volume of the EZ-Connect is approximately 1.0ml.*
- Slowly infuse lidocaine over 2 minutes.
- Allow lidocaine to dwell in IO space for 1 minute.
- Flush with 2-5 mLs of normal saline.
- Slowly administer subsequent lidocaine (half the initial dose) IO over 1 minute.

3. Hook power injector tubing directly to IO line hub.

4. Inject contrast through IO line. No guidelines exist on rates for injection so use lowest injection rate possible (up to 5cc/sec) for the study and do not exceed 300 psi.

5. Disconnect power injector tubing from the IO line hub and flush the IO line with 20 cc IO saline.

Injection Policy for Patients with a Single Kidney

It has been shown that there are no significant differences in the rate of AKI attributable to contrast enhanced CT in patients with a solitary kidney versus two kidneys. Therefore, patients with a solitary kidney should receive the same amount of IV contrast as those with two kidneys. This can be edited at the discretion of the supervising radiologist in patients with compromised renal function.

McDonald JS et al. Radiology 278;74-81:2016

Patients undergoing dialysis therapy who require IV iodinated contrast

For patients with end-stage renal disease (ESRD) on long-standing dialysis, iodinated contrast can be used safely. In this setting, residual renal recovery is presumed to be lost and therefor any potential nephrotoxic effect of contrast should not have substantial impact on patient outcome. There is no need to initiate dialysis immediately after receiving IV contrast. Timing of next dialysis session can be decided by patient's nephrologist.

Risk-benefit discussion is needed between radiologist and clinical team members if the patient is on dialysis and there is a chance of recovering renal function or the patient is on dialysis but is still making reasonable amount of urine. In this setting iodinated contrast should be avoided (but is not absolutely contra-indicated if a study is needed) to avoid any further injury to kidney.

Policies Specific to MRI Contrast Media

All MRI policies have been moved and are now centrally located within the YNHH MRI Safety Manual